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REVIEW PAPER

Selected epidemiological aspects of fresh whole blood application in the Polish Field Hospital in Afghanistan

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ABSTRACT

Minimisation of blood transmitted diseases is a basic element of all blood transfusion strategies. Civilian health service standards used in peacetime may be difficult to implement in a battlefield. The risk of blood -borne diseases depends on the applied donor qualification procedures and the epidemiological situation in the areas of military operations. The authors discuss various epidemiological aspects considered when selecting potential donors of fresh whole blood for a Walking Blood Bank at the Polish Field Hospital in Afghanistan.

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Key words: fresh whole blood, donor qualification, Walking Blood Bank, Afghanistan

INTRODUCTION

Despite increasingly sophisticated donor qualification procedures both for screening and pathogens inactivation, fresh whole blood (FWB) transfusions may still transmit diseases.

Since we have to supply FWB or components during military operations in Iraq and Afghanistan, we had to establish the safest possible procedures for battlefield transfusions. Throughout the Operation Iraqi Freedom (OIF), which was carried out from 2003 to 2008, the Polish Field Hospital received blood components from the U.S. Forces health services, because the logistic unit of the Polish Armed Forces was incapable of maintaining regular supplies of fresh blood. Whole blood and components, which were used in the Polish Field Hospital came from military blood collection centres in the U.S., in emergency situations FWB was immediately delivered to a battlefield by air [1]. Within a given time period, the U.S. health services operating in Iraq and Afghanistan implemented more complex procedures for collection and use of FWB in patients suffering from massive haemorrhage and associated coagulopathy. Thirty-six out of 281 (13%) patients received FWB during the first 10 months of OIF, i.e. from March to December 2003 [2]. In terms of safety, the procedures for transfusion therapy in the area of operations differed from those adopted by civilian health services. In the period April–December 2004, only one U.S. Combat Support Hospital required that blood donors were screened for HIV, HCV and HBV [3]. In 2006, the U.S. Forces developed and implemented uniform procedures for collection and application of FWB in field hospitals, which were later published in the Joint Theater Trauma System Clinical Practice Guideline [4]. In order to improve safety of the transfusion therapy, the procedures are modified each year. The risk of transmitting a blood-borne disease in operational conditions is much higher than in the civilian environment. However, the use of FWB in patients suffering from massive haemorrhage and associated coagulopathy has become a common procedure in the U.S. military field hospitals in the theatre of operations.

The Polish Field Hospital in Afghanistan, also known as a Medical Support Group (MSG), was establish in 2010 and is located on the premises of the Forward Operating Base Ghazni (FOB Ghazni). Medical personnel serving in MSG carry out tasks allocated to a Role 2 medical treatment facility — they cooperate with Forward Surgical Team (FST, Role 2, U.S. Forces medical facility located in the same military

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base). Needless to say, it is necessary that both, the Polish and American coalition partners, implement the same medical procedures. Due to the nature of injuries, e.g. massive haemorrhage, it is important that medical facilities operating in Afghanistan have the capability to supply an adequate amount of blood and its components to a battlefield. The total amount of FWB stored in the Polish MSG and in the American FST is insufficient. In 2012, Polish Field Hospital in Afghanistan adopted recommended procedures for FWB therapy in order to increase safety of patients. Additionally, Polish Military Contingent procured all necessary equipment and trained their medical personnel. Moreover, in order to ensure blood recipient safety, it was necessary to carry out medical investigation inside the area of operations, paying particular attention to the incidence of blood-transmitted infectious diseases.

SYSTEM OF FWB COLLECTION IN THE POLISH FIELD HOSPITAL IN AFGHANISTAN

The basic element of FWB collection system in the Polish Field Hospital in Afghanistan is selecting sufficient number of potential donors of fresh whole blood for a Walking Blood Bank (WBB). The rules regarding donor selection in a mission area are different from those applied by public blood donation centres in Poland. Polish blood donation centres act in accordance with the European Union directives as well as the national law, and thus they are obliged to meet a number of requirements regarding the use of FWB. One such requirement is that whole blood or its components can only be used if it had been screened for markers of blood-borne pathogens. In the operational conditions, and especially in mass casualty situations, screening of FWB is not always possible. In the peacetime, whole blood or components must undergo a series of tests for blood-transmitted pathogens before they are approved for therapeutic use. FWB must be tested for: HBs antigen, anti-HIV 1 and 2 antibodies, anti-HCV antibodies, RNA HCV, DNA HBV, RNA HIV, and syphilis. Blood samples for screening are collected during donations. Currently, the Polish Field Hospital in Afghanistan does not possess the capability to use methods of molecular biology for screening tests in emergency situations. They use serological tests instead. Those tests reduce, but do not eliminate, the risk of infection. Additionally, in order to facilitate the process of whole blood collection in emergency situations, all other procedures for selecting donors need to be maximally simplified, the least time-consuming, yet, possibly the safest.

EPIDEMIOLOGICAL ASPECTS OF FWB APPLICATION IN FIELD CONDITIONS

American experience shows that the risk of complications resulting from FWB transfusions (both for donors and recipients) is only slightly higher in a battlefield than in the civilian environment. This was confirmed by the data collected during the military operations in Iraq and Afghanistan and the retrospective analysis of more than 6,000 transfused units of FWB. In the period from 2003 to 2008, 2,831 whole blood samples were tested. HCV markers were detected in 3 samples and HTLV (human T-lymphocyte virus) in 2 samples. FWB transfusions may certainly transmit infections, yet, the benefits from the application of FWB therapy exceed the potential risk [3, 4].

According to the data from the National Institute of Public Health — National Institute of Hygiene in Poland, the prevalence of viral hepatitis B was estimated at 3.9 per 100,000 persons in 2009 and 4.3 per 100,000 persons in 2010. The prevalence of viral hepatitis C was 5.1 in 2009 and 5.2 in 2010. The prevalence of newly diagnosed HIV infections was estimated at 2.5 per 100,000 persons in both years [5]. In terms of epidemiology, the prevalence of diseases in the population of first-time donors corresponds to the prevalence observed in general population. The rates of infections amongst multi-time donors are lower than those observed in general population because of routine testing for blood-transmitted pathogens. As an example, the prevalence of HBs antigen amongst Polish first-time donors has been estimated at 0.5%, and this rate has not changed since 2009. While HBs antigen is rarely detected in the population of multi-time donors, its prevalence ranges from 0.001% to 0.0004%. As regards the prevalence of viral hepatitis C, the percentage of confirmed cases amounted to 0.36% in 2008 and 0.31% in 2011; in multi-time donors it was 0.01% and 0.02%, respectively. By contrast, HIV prevalence has increased from 0.98 per 100,000 donations in the period 2005–2007 to 2.04 in the period 2008–2010. It is alarming that the rise in HIV prevalence was also reported amongst multi-time donors [6]. According to the data published in the U.S. in 2008, the American Red Cross Blood Services collected 6,638,877 units of whole blood and blood components from 3,830,094 honorary blood donors, of whom 74% were multi-time donors. The prevalence of confirmed cases of infections per 100,000 donors was as follows: HIV — 5.11% in first-time donors and 2.16% in multi-time donors; HCV — 10.38% in first-time donors and 2.98% in multi-time donors; HBV — 6.34% in first-time donors and 2.62% in multi-time donors. The figures clearly demonstrate lower prevalence of infections amongst multi-time donors. The authors of the publication highlighted the fact that the number of HIV infections has remained at a stable level in multi-time donors, whereas it has fallen in the population of first-time donors [7]. The introduction of molecular biology methods to screen blood donor lowers the risk of transmitting infections, because it reduces the window period and makes it possible to

Table 1. Estimated risk of transmitting infections for different blood donor screening methods (according to Stramer et al. [8])*

Virus	Serological tests	Molecular tests	
		In mini-pools	In single donations
HIV	0.75 (1:1,300,000)	0.52 (1:1,900,000)	0.33 (1:3,000,000)
HCV	4.3 (1:230,000)	0.61 (1:600,000)	0.43 (1:2,300,000)
HBV	5.5 (1:180,000)	4.8 (1:210,000)	2.4 (1:410,000)

*Data refer to the United States, where the prevalence of HBV and HCV infection markers is lower than in Poland
Source: Grabarczyk P et al. Practical consequences of HBV DNA screening implementation in blood donors. Acta Haematol Pol 2009; 40: 45–54 [9]

Table 2. Estimated risk of transmitting viral infections by transfusion in the United States in 2012

Virus	Whole blood or red blood cell products
HBV	1:280,000–1:355,000
HCV	1:1,000,000–1:2,000,000
HIV	1:1,500,000–1:2,000,000

Source: UpToDate. Risk of viral infection following transfusion of blood products. Available at: www.uptodate.com. Accessed: Feb 2014

detect genetic material of viruses before the appearance of antibodies. An estimated risk of transmitting HBV, HCV and HIV infections for different blood donor screening methods is presented in Tables 1 and 2.

In terms of epidemiology, it is important to pay attention to parasitic diseases, as well as some viral infections caused by hepatotropic viruses. The risk for developing a parasitic infection, such as leishmaniasis or malaria, is relatively low in the areas where Polish soldiers are stationed.

Polish military bases are located in the areas lying more than 2000 m above sea level, where vectors of infection (mosquitoes transmitting malaria or sand flies transmitting leishmaniasis) are absent. Cases of malaria diagnosed in Ghazni province are typically imported from the lowland regions of the country. The incidence of malaria in Afghanistan has decreased over the last decade. In 2002, the World Health Organisation (WHO) estimated the number of malaria cases at 2.5–3 million per year. In 2008, the Afghan health service reported of 52,228 infections treated as malaria (21,148 cases were laboratory confirmed). The highest incidence of malaria was reported in Nangarhar, Badakhsan and Kandahar provinces. The Ministry of Public Health in Afghanistan has divided the country into 3 epidemiological strata. There are 14 provinces in the high risk, 15 provinces in the low risk, and 5 provinces in the very low risk for transmission. The majority of Polish military personnel have been deployed to Ghazni province, which is the stratum with the lowest risk of malaria transmission (Fig. 1).

Although the risk of malaria transmission in Ghazni province is relatively low, soldiers may become infected when they are relocated to different parts of the country. In 2010, a Polish soldier contracted malaria while he was carrying out his tasks in the vicinity of Jalalabad (Nangarhar province), where the risk for malaria transmission is high. Epidemiological interviews revealed that the majority of Polish soldiers serving in Afghanistan decide not to take anti-malarial chemoprophylaxis [10]. The questionnaires completed by Polish military personnel in the period 2012–2013 (DD572 Form) demonstrated that none of the soldiers selected for the WBB programme was using anti-malarial chemoprophylaxis throughout their stay in FOB Ghazni. Although the risk of transmitting malaria via blood transfusion is low, it is necessary to screen blood donors for Plasmodium. Malaria detection tests, which were carried out in the period 2012–2013, all proved negative. Another parasitic disease, which may be transmitted through blood transfusion is leishmaniasis. The disease occurs in 3 clinical forms: cutaneous (CL), visceral (VL) and muco-cutaneous (MCL). Approximately 90% of all cases of cutaneous leishmaniasis are diagnosed in Afghanistan, Brazil, Peru, Iran, Saudi Arabia and Syria. Kabul, the capital city of Afghanistan, remains the largest reservoir of CL in the world, with 65,000 diagnosed cases [11]. As in the case of malaria, the risk for contracting leishmaniasis in the mountainous Ghazni province is relatively low. Owing to the fact that infection vectors (sand fly *Phlebotomus*) are present in areas lying below 2000 m above sea level, military personnel deployed to Afghanistan is at risk of leishmaniasis during transfer to and from FOB Ghazni via Bagram Airfield, military base located 60 km from Kabul. Researchers have confirmed that leishmaniasis can be transmitted through blood transfusion. Intercellular form of *Leishmania tropica* and *Leishmania donovani* protozoa are able to survive up to 30 days in FWB monocytes and in platelet concentrates if stored at the temperature of 4°C, and at least 5 days, if stored at the temperature of 24°C. Transfusion-transmitted leishmaniasis was reported in China in 1948. At least 11 cases of post-transfusion infections with Leishmania parasites have been described in English-written medical literature so far. In 1991, Belgian researchers reported a case of transfusion-transmitted leishmaniasis

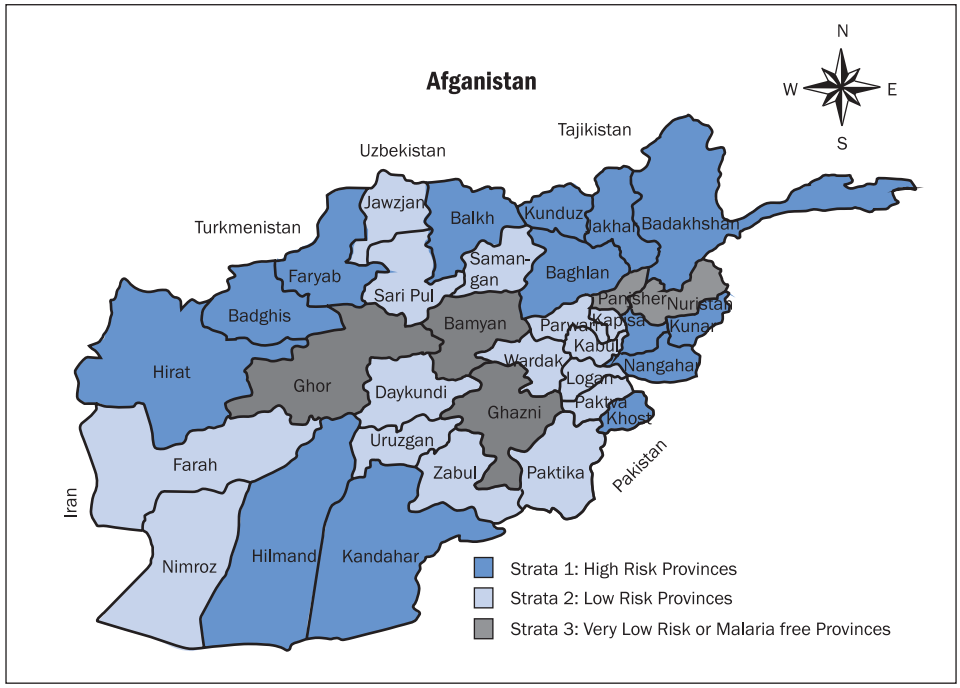

Figure 1. Stratification map of malaria in Afghanistan; Source: Islamic Republic of Afghanistan, Ministry of Public Health, Kabul 2008

in an 11-month infant, who had never travelled abroad [12]. With regard to transfusion safety, medical personnel need to be aware that asymptomatic parasitemia may persist for several weeks or even months, as is the case of *Leishmania donovani*.

Currently, there is no comprehensive epidemiological data available on blood-borne viral diseases occurring in the Afghan population. Studies conducted in the period 2003–2011 demonstrated HBV infections in 1.9% and HCV infections in 1.1% of the studied population (132 thousands of individuals). It is a well-known fact that hepatotropic viruses are mainly transmitted through the use of contaminated needles, unprotected sex or the use of untested blood. Research carried out in the Central Blood Bank in Kabul from March to December 2006 demonstrated that the prevalence of HBsAg in blood donors was 3.9%, and the prevalence of anti-HCV antibodies — 1.9% [13]. According to the reports published by the Ministry of Public Health of the Islamic Republic of Afghanistan (MoPH IRA), approximately 5,000 of Afghan citizens are infected with HIV. Nevertheless, there is no accurate data available on the prevalence of HIV in the blood donor population. The WHO estimated the HIV incidence rate at 100 cases per 100,000 donations. Due to the fact that military personnel operating in Afghanistan have limited contact with the local population and a self-sufficient system of medical support, the local epidemiological situation with respect to HBV, HCV and HIV transmission rates is of little importance to military contingents.

THE EXECUTION OF WALKING BLOOD BANK PROGRAMME IN AFGHANISTAN

The majority of Polish soldiers selected for Walking Blood Bank are active blood donors. Before being selected for WBB, a candidate has to complete a shortened questionnaire, which is uniform with the one used by the U.S. Forces health services. Candidates, who do not fulfill the mandatory requirements are disqualified from the programme. Once they have been selected, potential blood donors need to undergo a series of laboratory examination, including a complete blood count and tests for HIV, hepatitis B and C, syphilis and malaria. In emergency situations, all blood tests are performed retrospectively. Additionally, tests for AB0 group antigens and Rh group D antigen are carried out. The results of all tests performed in Afghanistan are retrospectively verified in Poland, serum samples (obtained by centrifugation) are transported to Polish laboratories and tested by means of molecular biology techniques. In order to detect viral infections in blood donors, rapid immunochromatographic tests are used. The sensitivity and specificity of the tests comply with the recommendations formulated by the WHO (99.5%) [14]. Immunochromatographic tests are also used for detecting malaria. In the case of *Plasmodium falciparum*, their sensitivity is 99.4%, and in the case of *Plasmodium vivax* it is 95%, their specificity is 99.3% for both species of *Plasmodium*. It is worth mentioning that such tests are not ordinarily performed in Poland, because Central Europe is a non-endemic area for malaria.

Table 3. Data of Walking Blood Bank programme and fresh whole blood collection in the Polish Military Contingent in Afghanistan in years 2011–2013

WBB/FWB	2011	2012	2013
Number of donors in WBB programme	74	144	102
Number of FWB donations after tests	19	82	68

Source: own studies; WBB — Walking Blood Bank; FWB — fresh whole blood

All tests, which are carried out in the Polish Military Contingent in Afghanistan are retrospectively verified in the Military Blood Donation and Blood Therapy Centre in Poland (all the tests performed so far proved negative). The transcription mediated amplification method is used for this purpose. The data on the Walking Blood Bank programme in the Polish Field Hospital in Afghanistan are presented in Table 3.

In emergency situations, when there is no time to perform any prospective diagnostics (not even immunochromatographic tests), blood donors are selected on the basis of epidemiological interview and medical examination. A potential blood donor needs to complete the U.S. Army DD 572 Form, which was earlier modified and adapted for the purposes of the Polish Military Contingent. Candidates selected for the WBB programme are not screened for leishmaniasis, as there is no legal requirement to perform such a test. Screening blood donors for leishmaniasis has been discussed, but because the transmission risk is low, the introduction of routine testing is pointless. Taking into consideration the epidemiological situation regarding leishmaniasis, it is important that candidates for FWB donors undergo a careful medical examination. Both ulcerative skin lesions (CL) or lymphadenopathy (VL) disqualify candidates from the WBB programme.

CONCLUSIONS

In order to provide adequate medical support to personnel operating in harsh conditions, we ought to introduce such medical procedures, which take into consideration local epidemiological situation and the type of tasks performed in the field conditions. Maintaining regular supplies of FWB and its components to a battlefield is one of the most difficult tasks that military health services are to handle. Civilian health service standards regarding FWB collection are impossible to implement in combat conditions. However, the experience of medical services supporting the Polish Military Contingent in Afghanistan in the period 2011–2013 shows that the use of FWB in military environment is sometimes necessary, regardless of the risk. As it has already been mentioned, the epidemiological situation regarding blood-borne diseases in Afghanistan is stable. Therefore, the collection and use of FWB appears to be relatively safe. In order to ensure safety of therapy, both prospective and retrospective diagnostic tests are performed. They include immunochromatographic and molecular biology techniques. Moreover, epidemiological interviews and physical examination of potential blood donors also increase safety of fresh whole blood therapy.

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